In-Class Research-Design Activities

RISKING FAILURE TO BE SUCCESSFUL
CHASE THE PROBLEM
TO MEET THE CHALLENGE
TO FLY THE DREAM

Here is your Challenge:

The Mission to Date:
Historical (Apollo) and current data (Lunar Surveyor) are being analyzed and a permanent Lunar Base site will soon be selected by your team. Robotic missions will then survey, deliver the base equipment package, and begin to prepare the selected site for the arrival of the lunar crew 6 months later.

Your task is to assemble two research teams. One will develop a Lunar Base Habitat and include the design details for a presentation back to NASA and the other will develop three potential lunar sites that will meet specific criteria and constraints but only choose and defend a final selection to NASA. This extended 30 day exploration and base assembly mission will be the first giant leap for Mankind in the building of a permanent human presence on the Moon!

Your Challenge is open-ended and involves a variety of collaborative and creative problem solving efforts!

- Research historical Apollo Command, Service, and Lunar Module.
- Design a LBH-30 and determine its architecture, gross weight, and size.
- Provide design details, systems, measurements, and capabilities
- Research past lunar landing sites, geology, and geography.
- Based on criteria – constraints, defend a lunar base location on the moon.
- Provide a visual and oral summary of your solutions.

Guidelines

Write the words “criteria and constraints” on the board. Ask students to define the terms. Explain that when designing any device, the inventor-engineer must consider criteria and constraints.

*The students should understand that **criteria** are standards or requirements <u>that must be included</u>. Examples of criteria are that the LBH-30 must utilize natural resources-geologic features on the moon, must house a crew of 2-5, and must be light and expandable for future mission use.*
***Constraints** are things <u>that limit the design</u> of the base. Examples of constraints are money, time, available materials, safe location, availability of lunar resource at the site, scientific interest for the site, and human capabilities.*

Design Team:

1. Under the title: “LBH-30 Criteria” write the following:
    a. The LBH-30 must house a 2-5 member crew on the moon for 30 days.
    b. The LBH-30 must demonstrate the beginnings of a permanent base that will be expandable at a later date.
    c. The LBH-30 must be as light (weight) and small (volume) as possible and still meet all the mission objectives.
    d. The LBH-30 team must provide detailed schematics or a 3-D model of the proposed LBH-30.
    e. The LBH-30 team must calculate, in general terms, the amount of food, air, water, waste, energy needs of the crew, and consider recyclable systems needed for 30 days on the moon.
    f. Teams will prepare a final presentation of results and understanding based on the scoring rubric.
2. Under the title: “LBH-30 Constraints” write the following:
    a. The materials used for the 3D model are only limited by team resources available to them.
    b. The LBH-30 solution must use as many natural lunar resources as possible.
    c. There will be a work-research-solution time limit set by the classroom teacher.
    d. Final team presentations will be limited by time, depending on the number of total presentations. Usually 5 to 6 minutes.
3. Using provided and additional resources students can now begin background research, gathering materials, design, and construct a model of the LBH-30.

Geographic Site Team:

1. Under the title: “LBH-30 Criteria” write the following:
    a. Longitude, Latitude, and nearby identified lunar features must accompany the selected LHB-30 site.
    b. The site must have identified natural lunar resources that can be used in the construction of the LBH-30 and provide protection for the crew.
    c. The selected power source should help determine the site.
    d. The site must consider scientific investigations of the moon and its environment such as geology, geography, astronomy, etc.
    e. The site must consider all aspects that will allow the base, in the future, to become self-sufficient and self-supporting.
2. Under the title: “LBH-30 Constraints” write the following:
    a. The materials and resources used are only limited by the research abilities of the team.
    b. There will be a work-research-solution time limit set by the classroom teacher.
    c. Final team presentations will be limited by time, depending on the number of total presentations. Usually 5 to 6 minutes.

Peer Evaluations

1. After student teams have completed their research and tasks, have different groups switch designs or solutions and evaluate each other's proposals.
2. In this evaluation process, the groups should focus on whether the design or solution meets the criteria and constraints up to this point and to offer any constructive criticisms or suggestions that would lead to greater success.
3. Once the groups have shared their evaluations, discuss as a class what the students learned from this peer evaluation. Lead a discussion using the following questions:
    a. Did your LBH-30 design or Lunar landing site meet the criteria and constraints?
    b. What is needed to make your proposal better, stronger, more complete?
    c. What changes would you make and why?
    d. What helpful comments did you get from the other group?
4. Explain to the students that an important part of the peer review process is having outside reviewers provide input that allows you to revise the designs or solutions prior to the final presentation.

Discussion/Wrap-up and Team Presentations

1. Have the students explain the steps they went through to meet the constraints and criteria set out in the Challenge. Ask the students if they think scientists and engineers follow similar steps. After the students have shared their ideas, explain that the students followed a very similar process to that of design engineers.
2. Explain that the basic design process includes: defining a problem, specifying constraints, exploring possibilities, selecting an approach, developing a design proposal or solution, making a model or prototype, testing and evaluating the design-solution using specifications, refining the details, and communicating the process and results to others.
3. Using the scoring rubrics for "PowerPoint Visual Design" and "Final Student Presentation" as a guide. Select the best student teams to prepare a 5 to 6 minute visual-oral presentation for NASA that includes details that meet the criteria and constraints of the Challenge, and demonstrates why this design and site is the best solution to the problem.

Teams should refer to the **VOCABULARY**, **RESOURCES**, and **BACKGROUND INFORMATION** sections of this Challenge as starting points and then expand through traditional and non-traditional sources for further research and information.

Solutions discovered and summarized into Student Presentation

Students will prepare a short, timed presentation to demonstrate knowledge, understanding, and verification of their solutions. Lengths of each team presentation (Base and Site together) will depend upon the number of presenting teams within the total time set for the second videoconference. The format includes student team presentations plus time for a NASA-DLN host to provide follow-up questions to each team.